3.2.8 Energy

3.2.8.1 Regulatory Setting

NEPA (42 U.S.C. Part 4332) requires the identification of all potentially significant impacts to the environment, including energy impacts.

The CEQA Guidelines, Appendix F, Energy Conservation, state that EIRs are required to include a discussion of the potential energy impacts of proposed projects, with particular emphasis on avoiding or reducing inefficient, wasteful, and unnecessary consumption of energy.

3.2.8.2 Affected Environment

The California Energy Commission (CEC) is California's primary energy policy and planning agency. SCAG's responsibilities include tracking and forecasting energy use in southern California. An Energy Working Group, as part of SCAG's Energy Planning Program, assists in developing energy policies consistent with the adopted plans such as the RTP and the Regional Comprehensive Plan and Guide. Over the past 50 years, energy supplies in southern California have sufficiently served the rapid growth in population and development (SCAG 2008).

The SCAG region, which includes Imperial, Los Angeles, Orange, Riverside, San Bernardino, and Ventura counties, consumes more than 23 million gallons of gasoline and diesel per day; vehicle fuel consumption in the region has increased more than 20 percent in the past 10 years. Energy in the project area is consumed for construction of private and public projects, operation of vehicles, and operation of existing land uses. Over the coming years, SCAG forecasts a substantial increase in energy consumption resulting from growth in population, households, and jobs (SCAG 2008).

In the project study area, energy is consumed primarily for residential, commercial, and transportation purposes. Transportation energy for motor vehicles is primarily provided by direct combustion of petroleum fuels (i.e., gasoline and diesel) with lesser contributions from compressed natural gas; electricity is used in a small number of electric-powered vehicles. The transportation facilities in the study area are already heavily congested and, consequently, support substantial energy consumption. Transit facilities operating within the study area corridor provide an alternative mode to the automobile, reducing the passenger's reliance on private vehicles and providing a more efficient use of energy.

3.2.8.3 Environmental Consequences

Evaluation Criteria

The project alternatives were evaluated to determine if they would result in a demand for energy that would exceed the current supply or cause a substantial increase in the rate of energy use.

Methodology

Direct energy is the fuel that goes to propel the vehicle under varying conditions of traffic. Indirect energy is all of the remaining energy needed to construct, operate, and maintain the roadway and manufacture and maintain the vehicles using the roadway. The analysis involves estimating the total amount of energy expected to be consumed. Both direct (i.e., operational) energy and indirect (i.e., construction/manufacturing and maintenance of the facility and vehicles) energy impacts were quantified using standard energy models, which use English units such as British thermal units (BTUs).

Direct energy consumption involves energy used by the operation of vehicles. In assessing the direct energy impact, consideration was given to the following factors:

- Vehicle mix, including light-duty vehicles, medium trucks, and heavy trucks;
- Annual VMT; and
- Variation of fuel consumption rates by vehicle type.

The direct energy analysis for each alternative was based on projected year 2040 corridor traffic volumes and total VMT. The 2040 daily traffic volumes for the study corridor were obtained from the project-specific traffic analysis contained in Section 3.1.6, Traffic. The daily VMT was annualized using a factor of 335 days per year. The VMT Fuel Consumption Method utilized for this project is outlined in *Energy and Transportation Systems* manual (Caltrans 1983)[19]. Energy consumption factors for the various modes identified in Table 3.2.8-1 were developed by Oak Ridge National Laboratory and published in the 1996 *Transportation Energy Data Book: Edition 29* (Oak Ridge National Laboratory 2010).

Indirect or construction energy effects involve the one-time, nonrecoverable energy costs associated with construction of roadways and structures, and construction and maintenance of the vehicles using the facility. Indirect energy is calculated by determining the energy equivalent

[19] According to the *Energy and Transportation Systems* manual, “The [VMT Fuel Consumption Method] is used when nothing is known about the transportation system other than the vehicle’s VMT. This method is most applicable for use with large macroscale regional or subregional transportation models, which will often output only the total VMT by mode. Generally, it would not be applicable for a project-level study of roadway vehicles” (C-9).

of all of the material products and operations necessary to keep the transportation system operable. The indirect energy analysis was conducted using the Input-Output Method, which converts either VMT or Year 2000 construction dollars into energy consumption. The analysis is based on existing data from other roadway improvement projects in the United States, utilizing conversions listed in Table 3.2.8-2.

Table 3.2.8-1: Energy Consumption Factors

Mode	Factor
Car	5,465 BTU[a]/Vehicle Mile
Personal Truck	6,699 BTU/Vehicle Mile
Motorcycle	2,212 BTU/Vehicle Mile
Demand Response[b]	16,509 BTU/Vehicle Mile
Transit Bus	39,906 BTU/Vehicle Mile
Rail-Intercity (Amtrak)	54,514 BTU/Vehicle Mile
Rail-Transit	62,601 BTU/Vehicle Mile
Rail-Commuter	94,587 BTU/Vehicle Mile

Note:
[a] BTU = British Thermal Unit, equal to the amount of heat required to raise 1-pound of water 1°F at 1 atmosphere of pressure.
[b] Includes passenger cars, vans, and small buses operating in response to calls from passengers to the transit operator who dispatches the vehicles.

Source: Oak Ridge National Laboratory 2010.

Table 3.2.8-2: Construction Energy Consumption Factors

Mode	Factor
Construction	
Automobiles and Trucks (manufacturing)	1,410 BTU/Vehicle Mile
Bus (manufacturing)	3,470 BTU/Vehicle Mile
Roadway (construction)	27.500 BTU/1977$ [a]
Electrical (TSM elements)	4,688 BTU/1982$ [a]
Maintenance	
Automobiles and Trucks	1,400 BTU/Vehicle Mile
Bus	13,142 BTU/Vehicle Mile

Note: [a]2010$ converted to 1977$ and 1982$.

Source: Caltrans 1983.

Utilizing the annual direct energy savings and the energy consumed for construction, a payback period was calculated. The energy payback period is the amount of time it takes to recover the quantity of energy expended for project construction. The energy payback period is determined by dividing the construction energy by the annual operational energy savings due to the project, as with the following:

Example

Construction Energy/Operational Energy Savings (Example Alternative-No Build) = Payback Period
240,000 barrels of oil/31,000 barrels of oil= 7.7 years

If the project would use more operational energy than the No Build Alternative, then there is no annual energy savings compared to the No Build Alternative, and the payback period would never be met. A payback period of fewer than 5 years is considered an excellent investment, while a payback period of greater than 20 years will generally be beyond the foreseeable future of the project (Caltrans 1983).

For the below analysis, BTUs have been converted to the equivalent barrels of crude oil for the comparison of alternatives.

Direct Energy (Operational)

Fuel consumption characteristics vary by vehicle type, but common factors used to broadly assess consumption include engine size, fuel type, weight, speed and cold starts for vehicle-related variables; and grade, traffic congestion (slowdowns or stop and go), and substandard pavements for facility-related variables. Lesser factors, such as driver behavior, altitude, and weather conditions, are not included in most fuel consumption analyses (Caltrans 1983). In this energy analysis, potential energy consumption of each alternative is compared to the future No Build Alternative condition rather than existing conditions. Table 3.2.8-3 summarizes projected direct energy consumption by alternative for Year 2040.

No Build Alternative

Under the No Build Alternative, the annual VMT for vehicles operating within the corridor is forecast to be approximately 1.78 billion miles in 2040. Given the VMT and vehicle fuel consumption on an annual basis, vehicles operating within the corridor are anticipated to consume approximately 1.68 million barrels of crude oil. During peak traffic periods, traffic congestion results in inefficient vehicular consumption of energy. Under this alternative, future vehicles operating within the corridor would continue to use fuel at an even less efficient fuel rate than current conditions.

Table 3.2.8-3: Annual 2040 Direct Energy Consumption[1]

Description	No Build	Alternative 1	Alternative 2	Alternative 3 (Preferred Alternative)
Vehicle Miles Traveled	1,775,161,650	1,810,715,200	1,846,268,750	1,860,533,050
Car	1,721,869,180	1,757,269,970	1,790,548,535	1,803,294,950
Personal Truck	53,292,470	53,445,230	55,720,215	57,238,100
BTUs Consumed				
Car (billions)	9,410	9,603	9,785	9,855
Personal Truck (billions)	357	358	373	383
Total BTUs Consumed (billions)	9,767	9,961	10,158	10,238
Total Barrels of Oil Consumed	1,683,969	1,717,502	1,751,486	1,765,249
Change in BTUs vs. No Build (billions)	N/A	194	392	471
Change in Barrels vs. No Build	N/A	33,533	65,517	81,280
Percent Change in Consumption (in BTUs or Barrels)	N/A	2%	4%	5%

Notes:
[1] Calculated based on factors provided in Table 3.2.8-1 (Oak Ridge National Laboratory 2010).

Alternative 1

Alternative 1 would result in a projected energy consumption of approximately 1.64 million barrels of crude oil based on approximately 1.81 billion miles traveled in Design Year 2040. Alternative 1 would result in the annual consumption of approximately 35,533 barrels more crude oil than the No Build Alternative. The project corridor is already highly developed, so it is unlikely that the addition of one lane in each direction would change travel patterns in the surrounding areas in such a way that would result in a sizeable increase in the expenditure of fuel, either within the study area or regionally. With this alternative, more vehicles are projected to use the highway in a given period, but each vehicle would be expected to use less fuel than under the No Build Alternative. In addition, TSM elements, such as the inclusion of ITS elements, would be included under Alternative 1, which would improve the flow of traffic, therefore helping to the offset increased fuel consumption.

With respect to minimizing energy consumption, Alternative 1 would incorporate energy conservation measures such as selecting energy-efficient project features (e.g., lighting, pavement surface), using energy-efficient design (i.e., reduced grades, decrease in out-of-direction travel, traffic flow improvements), including ramp metering, auxiliary lanes, and other

TSM/TDM measures, as well as bicycle and pedestrian facilities to further offset increased fuel consumption associated with the projected increase in VMT.

Alternative 2

Under Alternative 2, VMT within the corridor is forecast to be approximately 1.85 billion miles in 2040. This would result in crude oil consumption in 2040 of approximately 1.75 million barrels. On an annual basis, Alternative 2 would result in the consumption of approximately 65,517 barrels more crude oil than the No Build Alternative. Because the project area is already highly developed, it is unlikely that Alternative 2 would result in a fuel consumption increase above projected numbers due to changed traffic habits. With the addition of two lanes would come a decrease in congestion. While more vehicles are projected to use the highway in a given period, each vehicle would be expected to use less fuel than under the No Build Alternative. As under Alternative 1, TSM and other energy conservation measures would be included to help minimize energy consumption and help offset increased fuel consumption associated with the projected increase in VMT.

Alternative 3 (Preferred Alternative)

Forecasted VMT for Alternative 3 is 1.86 billion miles in 2040, and corresponding fuel consumption would be approximately 1.77 million barrels of crude oil. Despite these energy expenditures, priority treatment facilities, including the Express Lane Facility, have been calculated to save between 1,000 to 11,400 gallons of gasoline per day (Caltrans 1983). The Express Lane Facility would reduce congestion along the corridor and, in the process, increase fuel economy. Because the area along the project corridor is already highly developed, it would be unlikely that there would be an increase in vehicle fuel consumption above the projected value in the surrounding areas or regionally as a result of this alternative. On an annual basis, Alternative 3 would result in the consumption of approximately 81,280 barrels more crude oil than the No Build Alternative. With this alternative, more vehicles are projected to use the highway in a given period, but each vehicle would be expected to use less fuel than under the No Build Alternative. As under Alternative 1, TSM and other energy conservation measures would be included to help offset increased fuel consumption associated with the projected increase in VMT.

Indirect Energy (Construction and Maintenance)

The indirect energy consumption for each alternative is summarized in Table 3.2.8-4 and is discussed below. As described in Section 3.2.8.3, Methodology, if a project alternative would use more operational energy than the No Build Alternative, then there is no annual energy savings compared to the No Build Alternative and the payback period would never be met. A payback period of fewer than 5 years is considered an excellent payback, and a period of more than 20 years is usually beyond the foreseeable future of the project. Indirect energy consumption for this project has been assessed using these criteria.

Table 3.2.8-4: Indirect Energy Consumption – Construction and Maintenance[1]

Description	No Build	Alternative 1	Alternative 2	Alternative 3 (Preferred Alternative)
Construction				
Corridor Annual VMT[2]	1,775,161,650	1,810,715,200	1,846,268,750	1,860,533,050
Vehicles-Auto Mfg BTUs (billions)	2,409	2,458	2,505	2,523
Vehicles-Bus BTUs (billions)	6,156	6,280	6,403	6,452
Roadway BTUs (billions)	48,817	49,795	50,772	51,165
Electrical (TSM elements) BTUs (billions)	8,322	8,489	8,655	8,722
Subtotal BTUs (billions)	65,704	67,021	68,336	68,862
Subtotal Barrels of Oil	11,328,286	11,555,393	11,781,989	11,872,754
Maintenance				
Auto Maintenance (BTUs) (billions)	896	914	932	940
Bus Maintenance (BTUs) (billions)	23,329	23,796	24,264	24,451
Subtotal BTUs (billions)	24,226	24,711	25,196	25,391
Subtotal Barrels of Oil	4,176,833	4,260,488	4,344,143	4,377,706
Total BTUs (billions)	89,930	91,732	93,532	94,253
Total Barrels of Oil	15,505,119	15,815,881	16,126,132	16,250,460
Indirect Energy Savings	N/A	no savings	no savings	no savings
Payback Period	N/A	N/A	N/A	N/A

[1] Calculated based on factors provided in Table 3.2.8-2 (Caltrans 1983.).

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No Build Alternative

There would be some energy consumption due to new and ongoing construction activities under the No Build Alternative. According to the 2008-2009 List of Obligated Projects in SCAG's 2011 FTIP, there is one programmed project anticipated for construction within the study area: (ORA080916) roadway rehabilitation including pavement repair along I-405 from Bear Street to Fairview Road (SCAG 2010b). On the portion of SR-22 that overlaps with I-405 within the project limits (I-405 PM 20.8/24.0), two projects are currently in the construction phase: the I-405/SR-22 HOV Connector (EA 071621) and the I-405/I-605 HOV Connector (EA 072631), which are collectively referred to as the SR-22 WCC Project.

The primary indirect energy consumption associated with the No Build Alternative would therefore be the manufacturing and maintenance of vehicles for use within the study corridor, as well as Caltrans' highway maintenance. Under the No Build Alternative, approximately 13.56 million barrels of oil would be consumed through construction and maintenance activities. Because construction work associated with the proposed project would not occur, this alternative would consume the least amount of indirect energy.

Alternative 1

In addition to vehicle manufacturing, construction of structures, roadway, and other improvements, Alternative 1 would increase the short-term indirect energy consumed. Construction costs associated with TSM elements incorporated into Alternative 1 would also contribute to the use of energy, primarily for signal synchronization/controller upgrades, highway advisory radio, changeable message signs, and other TSM elements. Finally, vehicle maintenance would contribute to the energy consumed for this alternative. The future amount of crude oil use associated with the construction and maintenance of Alternative 1 is estimated to be approximately 15.82 million barrels. Compared to the No Build Alternative, there would be no indirect energy savings. This demand would be partially offset by long-term per-vehicle energy savings in the corridor due to improved traffic flows under Alternative 1.

Alternative 2

The same factors as in Alternative 1 would result in indirect energy consumption in Alternative 2. The future crude oil consumption for Alternative 2 is estimated to be approximately 16.13 million barrels. Compared to the No Build Alternative, there would be no indirect energy savings. This demand would be partially offset by long-term per-vehicle energy savings in the corridor due to improved traffic flows under Alternative 2.

Alternative 3 (Preferred Alternative)

The same factors as in Alternative 1 would result in indirect energy consumption in Alternative 3. The future crude oil consumption for Alternative 3 is estimated to be approximately 16.25 million barrels. The overall energy consumption for Alternative 3 would be the highest of all three build alternatives. Compared to the No Build Alternative, there would be no indirect energy savings. This demand would be partially offset by long-term per-vehicle energy savings in the corridor due to improved traffic flows under Alternative 3.

As outlined under CEQA and NEPA guidance, long-term operational, direct energy impacts would occur if a proposed project would place a substantial demand on the regional energy supply or require substantial additional capacity, or considerably increase peak and base period demand on various energy sources. Construction of any of the build alternatives would entail the one-time energy expenditure to manufacture building materials, prepare the surface, and construct the roadway and facilities. This expenditure would be balanced by the improved system efficiency over the design life of the proposed project.

Although all three build alternatives would result in increased energy usage, when compared to the regional energy use (i.e., the SCAG region consumes more than 23 million gallons of gasoline and diesel per day), the increased expenditure related to the proposed project is not considered to be substantial or adverse. The aforementioned TSM measures to be incorporated into each of the build alternatives would be designed and implemented with the intent of improving energy efficiency within the study area.

When balancing energy used during construction and operation against energy saved by relieving congestion and other transportation inefficiencies, the project would not have a substantial energy impact. Additional nonrenewable energy supplies used by each build alternative would not cause a substantial depletion of these resources.

3.2.8.4 Avoidance, Minimization, and/or Mitigation Measures

The proposed build alternatives would likely reduce the per vehicle energy use relative to the No Build Alternative. There would also be energy-saving components associated with the proposed project in the form of TSM improvements. Given these considerations, no avoidance, minimization, and/or mitigation measures are required for any of the alternatives.

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